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# ANALYSIS OF THE CONDITION OF CONNECTING ELECTRODES TO THE BODY OF THE PATIENT WITH THE APPLICATION OF A DEFIBRATOR

***Abstract.*** The application of defibrillators in medical practice is considered in the paper. It is shown that for automated defibrillators there is a problem of analyzing the wall of electrode connection to the patient's body during automatic defibrillator operation.
***Keywords:*** defibrillator, electrode condition, capacitive resistance.

## INTRODUCTION

Medical technology for diagnosis, treatment and resuscitation is used everywhere. Medical equipment companies are developing more and more new devices, and to date, many medical devices include a large number of different devices. Pulse devices are one such example of medical technology.

Pulse devices, namely defibrillators, are devices that restore the normal heartbeat by sending an electrical impulse to the heart. They are used to prevent or correct arrhythmias, irregular or too slow or rapid heartbeats. Defibrillators can also restore the heartbeat if the heart suddenly stops, namely to prevent dysrhythmias of the heart muscle, after which the body's natural pacemaker at the sinoatrial nodule of the heart is able to restore the normal sinus rhythm. [1]

## THE GOAL OF THE WORK

The purpose of this work is to analyze the connection of contact electrodes to the human body and the method of their use of universal defibrillator in emergency situations.

## TYPES OF DEFIBRATORS

Different types of defibrillators work differently. Defibrillators can prevent sudden death among people who are at high risk of life-threatening arrhythmia. These include implantable cardioverter defibrillators that are surgically placed inside your body, and portable cardioverter defibrillators that rest on your body.

Manual external defibrillators require the knowledge of a healthcare professional. They are used in conjunction with an electrocardiogram, which may be separate or embedded. The healthcare provider first diagnoses the heart rhythm and then manually determines the voltage and timing of the electric shock. These units are primarily located in hospitals and some ambulances. [2,3] Manual internal defibrillators deliver a blow through a contact group of electrodes placed directly on the heart. [2,3] They are mainly used in the operating room and, in some cases, in the emergency department during the open heart procedure.

Automated External Defibrillators (AEDs), which are found in many public spaces, have been designed to save the lives of people who have a sudden cardiac arrest. Automated external defibrillators (Fig. 1) are designed for use by unprepared or briefly trained non-professionals. AEDs contain heart rate analysis technology. As a result, it does not require the presence of qualified medical personnel. [2]

AEDs can be fully automatic or semi-automatic. [3] A semi-automatic AED automatically diagnoses heart rhythms and determines whether a shock is required. If shock is recommended, the user must press the button to control the shock. Fully automated ARD automatically diagnoses heart rate and advises the user to wait for the process to complete. Some types of AEDs come with advanced features such as "manual rework" or display.

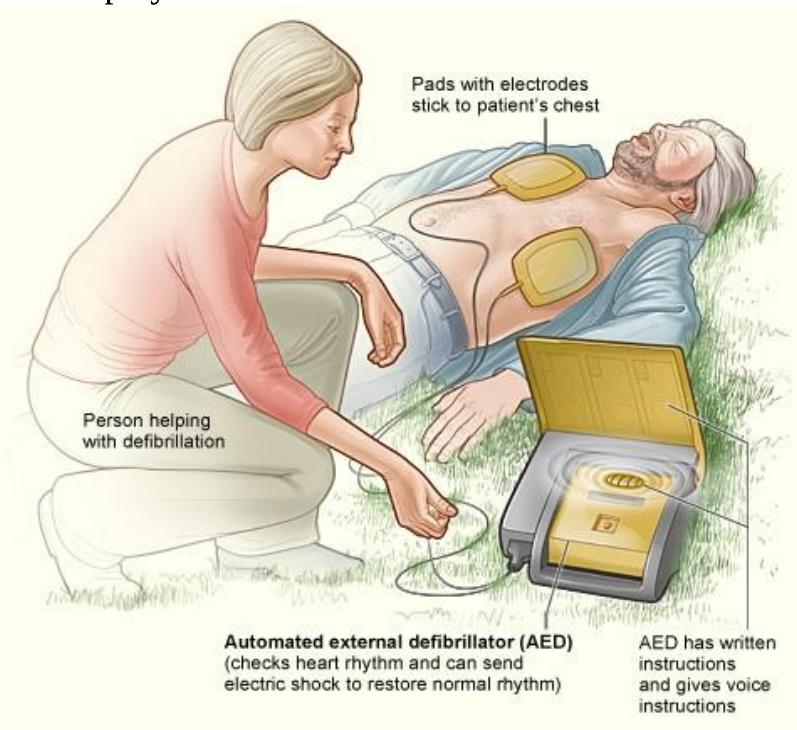


Figure 1. AED defibrillator when used [3].

It is also worth noting that widely used implantable cardioverter defibrillators, which are devices - implants similar to pacemakers (Fig. 2), and some of them can play its role. They constantly monitor the patient's heart rhythm and automatically introduce shocks for various life-threatening arrhythmias, according to the device's programming.

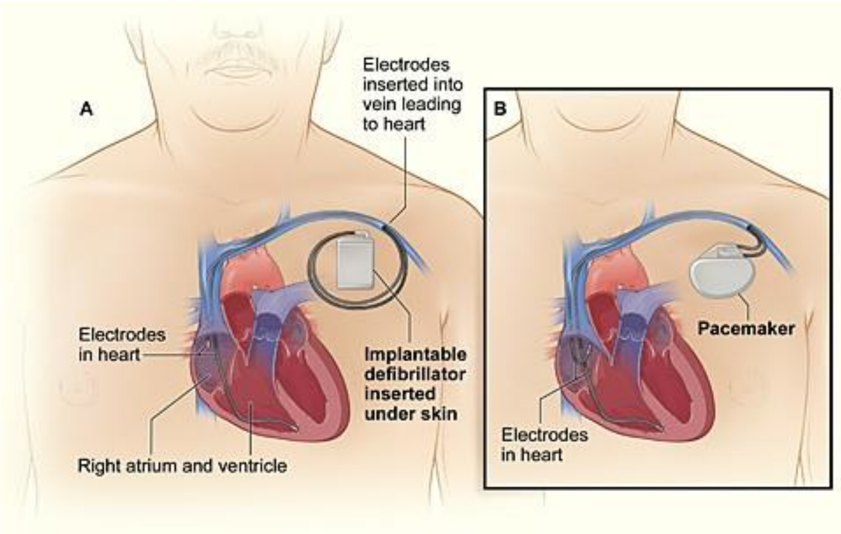


Figure 2. Comparison of implanted cardioverter defibrillator and pacemaker.

Many modern devices can distinguish between ventricular fibrillation, ventricular tachycardia, and more benign arrhythmias, such as supraventricular tachycardia and atrial fibrillation. When life-threatening arrhythmia is ventricular fibrillation, the instrument is programmed to immediately go into unshipped shock.

## ANALYSIS OF CONNECTING ELECTRODES TO THE BODY OF THE PATIENT

Some defibrillators actively monitor the electrode connections and are able to recognize when the electrodes are applied to the patient, and immediately start electrocardiographic (ECG) monitoring. Such defibrillators / cardio monitors are capable of measuring the impedance of the combination due to the cable-electrode-patient matching system connected to the defibrillator. When controlling only the matching cable and the electrodes, the defibrillator reads only the capacitive resistance of these components, and the measurement of the capacitance must be extremely small. Under these conditions, the defibrillator / cardio monitor will display a straight line on the ECG, since the resistance of the capacitance indicates that the electrodes have not been added to the patient's body. When the electrodes are applied to the patient's body, the capacitive resistance increases above the threshold, the patient's ECG signal is received, and the display is activated to display the ECG signal. The doctor or defibrillator (in automatic mode) can then assess the patient's condition and begin treatment.

However, when pre-connecting the electrodes with the help of a matching cable, a capacitive impedance that exceeds the threshold value can be created, even if it is minimal. The defibrillator / cardio monitor only then activates the display, replacing the straight line with the signals supplied by the electrodes. However, if the electrodes are not connected to the patient's body, the defibrillator will perceive the resulting low noise as an asystole state. This may result in an alarm for the healthcare provider. These unjustified alarms can create destabilization in situations where the patient's life is at risk. Accordingly, the ability of the defibrillator to recognize the combination of the matching cable and the electrodes as a patient's asystole state during pre-attachment should be prevented before the electrodes are connected to the patient's body.

An opportunity to avoid such a situation where the patient's life could be significantly endangered is to control the capacity of the combination of the matching cable and the electrodes, which are pre-attached to the defibrillator created by the bag or package in which the electrodes are housed. In order to provide a sealed, high strength electrode housing, a bag or bag containing electrodes is typically made of a multilayer metal foil. Since capacitive resistance can be created between the electrodes and the metal of the foil package, such capacitive resistance will be added to the capacitive resistance of those matching cables and electrode cables used in defibrillation. This capacitive resistance is reduced by the use of material with high dielectric constant on the sides of the electrodes, which are opposite the walls of the bag or package of foil, thereby preventing the recognition of a defibrillator of excess capacity, which can be misinterpreted as a state of asystole.

## CONCLUSION

Cardiovascular disease is the leading cause of mortality on Earth. According to WHO (World Health Organization), approximately 17 million people die from heart disease annually in the world, accounting for about 29 percent of all deaths. This indicates that the use of defibrillators is very relevant, but there is a problem of analyzing the state of electrode connection to the patient's body in the automatic mode of the defibrillator.

## REFERENCES

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